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MICRO-FUNGI:

WHEN AND WHERE TO FIND
THEM.



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INTRODUCTION.

THE writer of this little book on micro-fungi has been induced to undertake the task of preparing it as a first lesson to the beginner who desires to enter upon the delightful study. What may be called the dry and technical parts of the science have been omitted as far as possible. The varied attractions and endless sources of pleasure which Nature prepares for the student, from month to month, have been presented before him (so far as the writer was able) to tempt him onwards into a field of investigation where his industry cannot well fail of procuring for him a reward of innocent and lasting enjoyment. The writer has felt, as doubtless thousands of others have felt, the difficulty of the study as a beginner, and in the preparation of this book he has been most anxious to do away, as far as possible,

with such difficulties, and lead the student on through pleasant pastures to higher and more rugged ground, when other teachers may take the student in hand, and conduct him over the more difficult country, where he will find harder work, but where the pleasure will be the less.

All those who have made this study their own at once acknowledge that the teacher then required by the student is Dr. Cooke, whose admirable book, *Smut, Mildew, and Mould*, is so well-known and highly appreciated by the scientific botanist. Under the guidance of this book the learner may soon make progress in the technical and scientific portions of the subject. A wider field of investigation will be opened before him, and if in his journey over it he now and then comes upon difficult ground, he will not be disheartened, for by this time he will be well able to contend against the impediment, and go on his way rejoicing.

Now a few words as to the origin of this little work; it may truly be said to be purely accidental, the result of unexpected circumstances. When Mr. C. E. Davis launched out his useful monthly periodical, *The Northern Microscopist*, at the beginning of the year 1881, it occurred to me that I should like to ta-

vantage of the periodical, by permission of the editor, and insert a few hints from time to time as to the more easily to be found leaf-fungi in the neighbourhood of Manchester. At first the idea had reference only to the members of the Manchester Microscopical Society. The approbation which these local notes received induced me to enlarge them, and take in a gradually widening radius, until I conceived the notion of making them applicable to the country at large. When my monthly notes for the year were complete, the editor of the Journal, and other students of microscopy, urged me to publish what I had written, in a small volume as a guide to the young student; and ultimately, after some hesitation, I consented to do so. I have had to make considerable additions and alterations, so as to make the work of general application. The localities of my discoveries, or *finds*, as they are usually termed, whether local or otherwise, I have thought it well to retain, and I have added others of distant places for the benefit of the general reader. I find the division of the matter into months generally approved, although it is not strictly natural. It has the merit, however, of simplicity, and comes sufficiently near to the limits which nature has established to satisfy the wants of the younger student. I have therefore retained the monthly

division as the best mode of publication. As to scientific idea, if I had thought it desirable, it would have been an easy matter to have added scientific names and structure, but this I have carefully avoided, as my wish from the first has been to make what I wish to be accepted as the A B C book of microscopic fungi. I presumed to take a higher range, the cost of the work must have been greater, and the object I have had in view completely frustrated.

Now a few words as to collecting specimens : this is the first step to be taken, and some of my young friends complainingly say it is most difficult. Doubtless a beginner will frequently look in the most unlikely places, and finding nothing, return home disappointed. A few failures of this kind will generally be valuable lessons, which will indicate the means of success. If he be in earnest, he cannot but succeed sooner or later. Every new discovery will become a step in the ladder upwards. Then he may go on in his hunting excursions, and it will soon become a strange thing if even he returns home unrewarded. The reader, in his rambling, should provide himself with a tin vasculum, which he can carry in his pocket, and a book of about the size of a pocket-handkerchief, which he should also be able to carry in a pocket, and thus leave his hands at liberty. With these,

common strong pocket knife, he will be fully equipped for his ramble. If the weather be doubtful, a water-proof carried over the shoulder by a strap may be found useful. As a general rule it is as well that the micro-fungi as collected should be at once placed in the vasculum, so as to secure for them a certain amount of moisture until they can be examined at home, or laid out under pressure to dry, as may be desired. In many cases, especially of leaf fungi, it is desirable to select out at once the best specimens, and carefully place them in the book with sufficient pressure to keep them perfectly flat, until you have time to remove them into blotting paper after your return from your ramble. The specimens you desire to retain permanently should be carefully laid out on blotting paper, under moderate pressure, and the paper should be changed every two or three days, for about a fortnight, when they can hardly fail of being perfectly dry. They are then ready for mounting as opaque objects. In my own herbarium I have books of such objects. The size of the book is a small octavo, one volume being filled with clustercups. These are numbered after Dr. Cook's handbook, and I would recommend the student to adopt the same system. In all my gatherings I have found great advantage in the plan. If the student desires to examine a puccinia,

or any other smut which he may find, let him first put a drop of clean water on the centre of a glass slide, then with the point of a knife or a needle take a small portion of the smut, and place it in the water, cover it with thin glass. If the object be then placed under the lens of the microscope, he will at once be able to see its structure. Should he desire to mount the specimen as a permanent object, let him remove the thin cover and allow the drop of water with the object in it to dry, when it will adhere to the glass, and may then be mounted in Balsam Damar, or any other media, at the discretion of the student. When the object will not stand up of being mounted in balsam without injury, I prefer not to use it, but in delicate vegetable tissues, I find it necessary to use other transparent fluids. This subject of mounting is, however, too long for me to enter upon here. Fortunately there are cheap pamphlets upon the subject within the reach of the student, and to them he must refer him.

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JANUARY.

IF there be any one branch of botanical study more likely than another to attract the special attention of the student of microscopy, it is the study of the minute fungi. Wherever his home may be, they come around him from month to month on all sorts of decaying or dead organisms—animal and vegetable. They float in the ponds and ditches, and their invisible spores are carried through the atmosphere in every possible direction, even along our streets and into our dwellings, especially our cellars. Most of these decompose for want of the required nidus, but countless thousands are developed into active vitality, and bring into existence most beautiful organisms. Now in this dead time of winter we have them in all damp places around our homes, often on the bread we eat and in the water we drink, on our cheese, and if we eat the tinned meats our cousins send us from Australia we may find the fungus there, in the shape of a hateful white patch.

If we scan with careful eye our window panes we may find house flies who have sought out quiet corners where they might die, and there upon their dead remains we find a mass of minute white threads which are the filaments of a well-known and interesting fungus. Amongst what may be called the domestic fungi, we have that still worse family pest the ring-worm; in worm or any other animal, but a bona-fide plant, well known and identified. A scientific friend of mine suffered some years ago from the infliction of this so-called ring-worm in his beard. He caught and tested the structure of the unwelcome visitor, and sent me specimens of its organism, including the spores. My friend, Mr. Tozer, the head of the fire department of our Manchester Corporation, a year or two ago sent me specimens of the ring-worm which had got upon many of his horses, and was breaking up the hairs into strange fractions of diverging fibres. Doubtless many of the diseases we suffer from have their origin in fungoid life, as yet only suspected, but may some day be known and eradicated. Already science has done much in this direction, but a wide field still remains to be investigated. The *Sarcina ventriculi*, a so-called fungus when I began my microscopic study, but now looked upon as a Confervoid Alga, has played sad havoc with the human stomach. It is but recently that this little vegetable monster has been known, and even now it is a difficulty and a puzzle to the medical student. So during all the centuries of

man's existence it has been doing its deadly work in the dark, disordering his vital functions, and doubtless abbreviating his span of life.

I remember a certain shoemaker in Sheffield, who some 30 years ago, was a sufferer from this pest unknowingly for a considerable period, and who was greatly reduced from being a very stout man to pitiful thinness, when a microscopist and a personal friend examined the fluid the shoemaker vomited, in which he at once detected the *Sarcina*, and he told the sufferer that he had got the *Sarcina ventriculi* in his stomach. The poor fellow was horrified, thinking it must be some huge monster. Explanation followed, and the proper medicine soon destroyed the unwelcome guest.

From what I have said it will be seen that the study of the minute fungi is not only a pleasant occupation, and a matter of general scientific interest, but it is in a certain sense a duty we are bound to fulfil in our own interest, and for our personal protection and the public good. Before leaving this department of study let me refer to the Ergot of Rye, a minute fungus of the genus *Claviceps*. This taken in household bread has been known to produce the most fearful results, upon the details of which it is not desirable that I should dwell.

It is not for the medical student, but rather for what may be called the botanical student, that I write, that I may aid him in those studies which will be to him a pleasure rather than a profession. About this time of

the year, with the prospect of spring before him, the student will be thinking of the leaf fungi, which are not yet nor can they come for some two or three months; but numerous others are to be found in woods and meadows, and elsewhere in places innumerable. I hope to have an opportunity next month of calling the attention of the student to some of these, in the meantime I may not inappropriately conclude by quoting the well-known inscription on the tomb of Sir Christopher Wren, in St. Paul's Cathedral, London, "*Si monumentum quaeris circumspice,*" for truly monuments of nature's handy work are all around him.

In concluding this paper for January it may be well to allude more specifically to some of the domestic pests which I referred to above. The too common one on bread is known as *Ascophora mucedo*, and will be familiar to every student of microscopy. This is the only species we have of that genus. Then we have the Mucors, of which many species are well-known. *Mucor mucedo* on fruit, preserves, &c. *M. claratus* on decayed fruit, as also *Mucor amethysteus*, which is the especial fungus of rotting pears. Then we have *Mucor caninus*, of the dung of cats and dogs, and numerous others, which I must leave to another occasion, through space at my command being fully occupied.



FEBRUARY.

ABOUT this time when a large proportion of the potatoes and cabbages, and other vegetable wares of the market gardener have been sent to our large towns for sale, the unsaleable roots and stalks are scattered about in the fields or around the home of the grower. Now these well deserve the attention of the microscopist, for such organisms when in a state of decay, and especially after wet weather, are often more or less infested with very interesting fungi. One of them, *Torula herbarum*, I have met with in large quantity on decaying fibrous rootlets of potatoes in the neighbourhood of Manchester and elsewhere, as also on the stalk of cabbage. This fungus assumes the form of a black powder bursting through the cuticle of the plant. The atoms of powder or rather spores, for such they are, adhere together and form strings. Decayed stems of umbelliferous plants are frequently infested with this same *Torula*. Dead

branches of willow often develope another species a *Torula stilbospora*, and indeed almost all the dead rotten sticks that may be found in a forest are liable to be infested with one or more species of *Torula*.

It is too soon in the year to look out for leaf-fungi but there is even now one such which grows upon the leaves of camellia. The first indications of the fungus will be found in the existence of a roundish brown patch on the leaf, which by degrees becomes white, and then extremely minute black spots are quickly developed upon it. These when broken up by pressure in water are found to be filled with very small sporidia, made up of about three cells and decorated with very singular appendages. The name of this curious fungus is *Pestalozzia guepii*. Dr. Cooke mentions others on the Cypress and on chips. These I have not met with, but I have found one not referred to by him on various pitcher plants, and especially on *Sarracenia flava*. The queer appendages connected with this fungus are more distinctly seen than are those upon the camellia leaf—*P. guepii*. One of the most interesting micro-fungi to be met with during the winter is *Asterosporium Hoffmanni*. It must be looked for upon dead twigs of beech, and is said to be common, but I have not frequently met with it. The spores are made up of three or four compound cells, artistically arranged, and if the student succeed in obtaining a good slide of

hem he will realize a large amount of pleasure in the examination of it.

After a farmer has used straw for bedding his cattle, he will frequently throw it in heaps about the home-
stead, and it will lie there until it is completely saturated with rain water. I have often met with it in this condition, and whenever I have I have in every instance met with an interesting fungus known as *Chætomium latum*, or "Straw Bristle-mould," as it is called. This is well worthy the search of the student, and not difficult to find, indeed it is one of the commonest of the microscopic fungi.

There is an interesting fungus on onion peel, *Aspergillus nigrum*, which is also found upon other organic tissues; but I have met with it in the most perfect state on Portugal onions; sometimes on the outward layers of the covering, and not unfrequently on the inner layers of the onion itself. The student will not have much difficulty in meeting with this object, for its intense blackness betrays it, and it is well worthy of his attention. There are other species of *Aspergillus* on damp paper, on rabbits' dung and other organisms, but it must suffice for me to have indicated the subject generally.

Upon the dead leaves of trees now lying on the ground in a state of decay numerous small fungi may be met with, amongst them the *Fusidiums* are pretty plentiful and well deserving of examination. They are

of various colours, white, yellow, or grey. *Fusidium flavo-virens*, the yellow variety, I found on oak leaves plenty long ago. The white variety, *Fusidium album* may be found in almost any locality where the oak itself grows. There is another interesting fungus which infests a large number of the dead leaves which now cover the ground in the woods, and is most distinctly visible as a white patch. It is *Cylindrium septatum* and is when seen under a $\frac{4}{0}$ th or $\frac{1}{4}$ inch lens a most interesting object. Upon wood far gone in a state of decay, I frequently meet with micro-fungi of interest. *Egerita candida* I have found frequently in Hough End Clough, which is within the reach of the smoke of Manchester. On examination with the microscope it is found to consist of white round balls, and is well worthy of a place in any cabinet. The various species which I have referred to are a selection from an innumerable host which have been brought into existence since the winter came upon us, and are of great interest to the scientific student. Being unable to name all, I have preferred to refer to such as may be most easily identified by the young beginner in this branch of study.



MARCH.

In the paper for last month I referred to the deeply interesting microscopic fungus *Pestalozzia Guepii*, with its strange appendages, and I now take the opportunity of informing the readers that this fungus may be found all the year round when the surrounding conditions of the camellia are favourable to its development. In one conservatory close to Winchester, I could at any time in bygone days if I required a specimen, at once procure it, and it must be in unusually healthy conservatory where the fungus is never developed. Now the spot referred to above is covered with houses, and I have to go farther away if I require specimens. The appendages are an excellent test as to the defining powers of a lens. In my earlier efforts in the examination of the fungus I was greatly puzzled and quite unsuccessful in my attempt to solve the difficulty. I employed a quarter inch, not a bad one by any means, but it had not the defining power neces-

sary to the case. I then got a sixth, when with careful manipulation of the light I succeeded in obtaining a perfect picture of the wings (for such there are) of this obscure, but very beautiful and very minute fungus.

The rains of autumn and winter, with the gradual decreasing temperature, bring before us numerous *Sphæriacei*, to some of which I called the attention the reader last month. About six hundred species of this interesting family may now be met with around, but more especially in woods and wood districts. Broken dead sticks and rotten wood in all possible conditions of decay form the soil or nidus upon which they prefer to vegetate. In such districts and under such conditions the reader will have no difficulty in finding them. I have met with various species of them on logs of wood lying on the road sides and in fields, also on dead tree roots, some of them as rare as they are beautiful. *Sphæria Pulvis-pyrius*, Gunpowder *Sphæria* is one of these, the latter name conveying an excellent description of the fungus with its powdery black atoms. *Sphæria pulveracea* or dust-like *Sphæria* is another having a similar appearance. Then there is *Sphæria spermoides*, having also a somewhat similar appearance, and others too numerous to mention. Some of the species are larger and more conspicuous, having the appearance of small cannon balls, but they assume various shapes and the larger proportion of them

are black. On the dead stems of umbelliferous plants *Sphæria rilis* may now be found in woods in great plenty, and on dead rose stems *Sphæria hypotephra*; indeed, so numerous are the members of this family that it is difficult for the student not to find them. Two of the most plentiful and certainly two of the most interesting are found upon the dead stems of the common nettle and the dead stems of the potatoe plant, the former is *Sphæria urticæ*, the latter *Sphæria herbarem*, this is found also on other dead stems and is very common. One of the most conspicuous members of this large family is *Xylaria hypoxylon*, it grows in tufts and is commonly known as candle-snuff fungus, from the circumstances of the top of the fungus being covered with a white powder, having the appearance of the burnt ashes of candle-wick. The supposed candle is a black upright fungoid stalk, of usually from half an inch to two or three inches in height, and a thickness of a leather shoe string. The fungus is not difficult to find. Tree stumps rotting in the ground, in hedges or woods, are annually infested with it. The white powder is found under microscopic examination to be a mass of minute organisms which the young student may suppose to be spores, but they are known as Conidea, and the true spores are to be found in Ascii, which are in the black portion of the fungus. Amongst the family I am now speaking of, the *Sphæriacei*, of which Dr. Cooke, in his valuable hand-book, gives a list of about six hundred

species, the *Peziza* occupy an interesting position. Many of them are comparatively large while others are extremely minute, yet they all partake of common characteristics and many of them are extremely beautiful in colour. Some are black, others white, but the gay bright colours are most prevalent, such as red, orange, yellow, brown, and purple, in all imaginable shades and degrees of beauty.

Peziza Calycina, I have frequently found on dead fir branches in Cheshire and Lancashire, and it may be found in any county in England. It is of a bright orange colour, and the fruit assumes the form of a small button. Sections of this fungus show the sporidia in asci very distinctly, and are deserving a place in any microscopic cabinet. *Peziza Coccinea* and *Peziza rutilans* are both developed upon moss in damp localities. Their bright red colour makes them very conspicuous, although they are not large, these and numerous others are equally worthy of the attention of the student. There are other gaily coloured small fungi growing from the ground amongst dead leaves, or in sheltered places chiefly in woods, similar in thickness and shape to the candle-snuff fungus, but consisting of one solitary organism to which I desire to refer. These vary in colour, red, yellow, and white, with intermediate shades. The most interesting of this group, *Torrubia* as they are called, grow from the dead bodies of the larva of insects, as the student will see on digging up the

fungus and examining what might be supposed to be its root. I remember the great pleasure I had in my first find of one of these strange plants. It was in Agecroft wood, near Manchester, some years ago, when its glaring colour amongst dead leaves betrayed it. The species I found was *Torrubia gracilis*, and was about an inch in height and rounded towards the top. One species *Torrubia entomorrhiza* has a rounded nob at the top, and there is one species where the fungus assumes the form of a tuft, this is *Torrubia militaris*. How it is that these fungi will only live upon the dead bodies of the larva of insects is a mystery which I will not attempt to solve. Numerous other similar frantic fancies in the vegetable kingdom might be given, but the subject is outside of my present intention.

In dealing with this numerous family of *Sphaeriacei*, I have endeavoured to call the attention of the reader to such as may be most easily found and recognised, and thus furnish him with a general idea of their habits and structure, and what to look for. To do more than that was an impossibility in the space at my command. Let him become familiar with but the few which I have imperfectly indicated, and he will become influenced by an increased desire to know more, and then he may take advantage of the many excellent works which exist on the subject.

The leaf-fungi come pretty largely to the front in next month, and I have only once been so fortunate as

to meet with a specimen so early as March. This occurred when rambling near Bangor in Ireland, in 1881, when I found the clustercups on *Caltha Palustris* or Marsh Marigold, *Aecidium calthæ* in excellent condition. Others may occasionally find leaf-fungi thus early, such cases may I think be looked upon as exceptions to the rule.





APRIL.

WE now enter upon the season of the year when buds prepare to burst forth into full leaf, and the vegetable kingdom generally prepares to put on its summer garb. The trees are as yet mostly bare, for their fully developed leaves have not yet opened; but amongst the humble plants whose home is upon the somewhat warmer earth, the leaves are open and the flowers of the spring time now appear to claim the attention of the field naturalist as he takes his ramble in the meadows. Now the student of microscopic botany will feel inclined to overlook the dead sticks of the woods, which have for several months had his attention, and look out for the living leaves of the plants which promise to provide for him a pleasant study in the leaf-fungi which are in preparation. Of these plants of the early spring-time, the one that I have in all cases found to be the first infected with leaf-fungus is the *Ranunculus Ficaria* or *Lesser celandine*, known better in

Lancashire and Cheshire as the Pile-wort. The batteⁿ cup-like flower of this plant makes it very conspicuous and it cannot well be overlooked. Upon the leaves of the first and one of the most beautiful cluster-caps of the year now makes its appearance. When mature it is of a bright yellow or orange colour, which contrasts strikingly with the green of the leaf, and is thus easily recognised. It belongs to a large family, the *Aecidiaceae*, of which we shall have frequently to speak in the coming months. This species is known as *Aecidium ranunculacearum*, and assumes the form of a small cup, hence its common name. This cup in its perfect condition is filled with minute spores of the colour of the cup itself. A number of the cups are usually clustered together, and form a striking patch on the leaf, varying in size, but commonly about the size of a small pea. This fungus, when carefully dried and mounted, as an opaque object for the microscope, is exceedingly beautiful and worthy of an honourable position in any cabinet. This first spring leaf-fungus I have frequently found in various districts of England and Ireland, and every spring during many years, when I have cared to look for it, in the Cheshire valleys, not far away from Manchester, and in great quantity near the village of Gatley, among the meadows known as the Cars.

The second fungus of the spring, so far as my own experience is concerned, is also to be found upon the leaves of this same plant, the Pile-wort. It assumes the

form of a small black patch, and is a smut, to use the common name by which it is known. The scientific name is *Uromyces ficaria*. There are also other members of this family of which we shall have to speak as the summer advances. The powdery smut which forms the black patch, on examination with a good microscope, is found to consist of a countless number of cells of extreme minuteness. These are too small to be well examined as opaque objects, but are capable of being preserved as microscopic objects of interest if mounted in balsam, damar, or gelatine. If the student desires to examine them only, not caring to preserve them, water is the best fluid to use.

Besides the above, which I have so frequently met with, I have a specimen of clustercups in my cabinet from Dawlish in Devonshire, which is in fair condition, sent to me by a friend. It is *Aecidium bunii*, or the "Pignut clustercup." It is not upon the Pignut, however, but upon *Buniam bulbocastanum*, and was found as early as April. It may be well to mention that I have the same species of fungus on the true Pignut plant, *Carum bulbocastanum*, which I found in North Wales, May, 1872; and again the same fungus which I met with in July of last year at Bootle, in the Lake District, and this time it was on another plant, *Pimpernella saxifraga*. It will be well to notice the various species of micro-fungi which are prominent in the month; but it must be remembered there are but

few if any of them who limit their appearance to any exact period : therefore all classification as to time must not be accepted as strictly accurate. It may be well for the student also to notice that although I speak of the same fungus growing upon the three completely distinct plants, this habit of growth must not be understood as usual, for on the contrary, it is rather the rule for fungi to accept one special plant as their home, and the name of the parasite usually follows in some form the name of the plant upon which it grows. I have another specimen of fungus, *Puccinia heraclei*, which has been met with thus early in the year in the south of England. It infests the Hogweed or Cow Parsnip, *Heracleum Sphondylium*. There is a probability that other leaf fungi may occasionally be developed thus early in the spring of the year in warm sheltered places and under other favourable conditions.





MAY.

AS we enter upon the month of May we find leaf-fungi come to the front in great numbers, especially the clustercups. The few named for April are still to be found in most cases, and if the season be a backward one, they will be now in better condition than they were in that month. The beautiful white clustercup, *Æcidium leucospermum*, is one of the first which makes its appearance in May, and is very common in some special districts; but I have only met with it in the Lake District and in Wales. It is only to be found upon the leaf of the wood anemone, *Anemone nemorosa*. It is easily recognised. Another of the early ones is the clustercup *Æcidium allii*, on the leaf of the garlic. This I believe to be very rare, for it cost me nearly twenty years' search before I was fortunate enough to find it when I was rambling on the shores of Windermere Lake, in May, 1877. The nettle clustercup, *Æcidium urticæ*, is more common, but is still rare in

many districts. I have met with it in the Bakewell Valley, in North Wales, and in various localities of the Lake District, as also in unusually fine condition in Sherwood Forest. *Lapsana communis* is a very common plant, and becomes the frequent home of one of the May clustercups *Ecidium compositarum*—variety, *Lapsana*. This I have found near Manchester whenever I have cared to look for it, and I doubt not it will be equally common elsewhere. I have another specimen of the compositarum clustercups found in May, but this I have never been able to meet with, it is *Ecidium compostarum*—variety, *Jacobeæ*, and is upon the common ragwort. It was gathered by a scientific friend near to Lynn, in Norfolk.

Another comparatively common cluster cup which may be found this month is the one on the field violet *Ecidium violæ*. The probability is that wherever the botanist meets with a bank of these favourite plants, and has any strong desire to find the fungus, he can hardly fail to succeed in doing so. It would weary my reader where I to enumerate the many places where I have met with this very beautiful parasite, when in good condition it is one of the best specimens of the very interesting family to which it belongs.

I think it is well that I should put upon record, for the information of the reader, the names of a few other clustercups which I have in my collection, which I have not been able to find, but are the contributions of friends.

look upon them as rare, but it is not impossible they may be, under special circumstances and under favourable conditions, comparatively plentiful. They were all found during this month. They are as follows : *Ecidium ari*, or Wake-robin clustercup, on *Drummacutatum*; *Ecidium geranii*, Cranesbill clustercups, on *Geranium pratense*; and *Ecidium crassum*, Buckthorn clustercups. I have also a specimen of the rare clustercups on *Caltha Palustris*, *Ecidium Calthæ*, sent from Scotland in May, 1874.

Now, a so-called rust may be found upon the leaves of numerous plants. The fungi which assume this common name of rust are extremely numerous, and they are of all shades of colour, from nearly black, through brown and yellow to orange. The genus *Trichobasis* is of the rusty sort most common and conspicuous, and now the reader in his country rambles may readily find various specimens of it, if he be in a favourable district, away from a smoky atmosphere. Above we spoke of the clustercups on the *Geranium pratense*, we have also the *Trichobasis* on the same plant, which I have gathered in this month, and it will linger on for several months to come, as is proved by the fact that I have specimens gathered as late as September. *Trichobasis rubego-vera*, also rust, may now be found on grass, and is easily seen in consequence of its bright colour, as it gradually bursts the cuticle of the plant, and thus exposes itself to the passing traveller. The spores which form the chief

mass of the plant are mostly simple rounded cells without a peduncle attached, and are thus easily distinguished from the genus *Uromyces* which possesses such an appendage of considerable length, as is at once demonstrated when the fungus is tested by microscopic examination. One of the commonest of these rusts is *Trichobasis heraclei*, of a bright orange colour, and grows upon numerous plants, and is but the early condition of a fuller developed organism known as *Puccinia heraclei*. It should be borne in mind that a large proportion of the rusts now beginning to make their appearance are not in any sense perfect fungi, but merely the early conditions of those which will appear when the conditions of their development shall be perfected. Of various of these complicated organisms I shall have to speak hereafter, but I refer to the strange fact now, in order to give the student an idea of the marvellous world of interest he has to deal with.

Another genus of the rusts also become plentiful in this month, and are known as *Uredo*. They infest a considerable number of plants, and like other rusts are not difficult to meet with. The spores are yellowish and vary in shade, and the simple cells of which they are composed are more irregular in form than the *Uromyces* or *Trichobasis*, and in no condition of their existence have they a peduncular attachment. During the month I have met with the fungi of this genus frequently in various parts of the country, but it is not desirable that

I should even attempt to make out a list of the species which he should particularly look for, he cannot get wrong in gathering specimens, although he may for a time have a difficulty in naming them. There is, however, another genus of these rusts which come forth largely in May, and cannot be overlooked, the name of which is *Lecythea*. The general appearance of the various species which make up the genus is very similar to that of the other rusts of which I have spoken, and the student will only be able to make out the distinction on careful microscopic examination. The varying characteristics of the spores in this instance are such as to make it difficult to convey the true idea to the reader, and it appears to me that I cannot do better than copy the description given by Dr. Cooke in his admirable Hand Book. It runs thus: "Stroma surrounded or sprinkled with elongated abortive spores. Spores free, invested with their cell, or concatenate." I will now conclude this portion of my notes for May by referring to a few of the species which the reader may expect to meet with in his rambles at this season.

Lecythea Rosæ, Roserust, on leaves and stem of roses.
Lecythea Poterii, Burnetrust, on *Poterium sanqisorba* and other plants. *Lecythea saliceti*, common Willow rust, although considered an autumn rust, I have met with in the present month.

Some of the *Pucciniæi* may now be found, and are the advanced species of a large army of followers, of which

I must speak more fully afterwards, and I think I may best close my paper for the month by naming a few I have met with in my May rambles. *Puccinia umbelliferarum* I have found during the month, I think I may say hundreds of times, for it is very common on the pignut plant. I have found it also on other umbelliferous plants. The *Puccinia ægopodii* on Goutweed, although looked upon as rare is very common in the Cheshire valleys, within about six miles from Manchester, and I meet with it every spring, and not unfrequently far into the summer. There are others of the *Pucciniæi* which I have but once met with in this month, and I will close this paper by a list of them for the readers' information. *Puccinia chrysosplenii*, Golden Saxifrage brand; *Puccinia vincae*, Perywinkle brand; and *Puccinia truncata*, or Iris brand. Later on in the year a crowd of members of this group of leaf-fungi will claim our attention.





JUNE.

THE month of June is exceedingly rich in leaf-fungi, many of the most beautiful of them may be met with during the entire month. The *Æcideacei* are especially plentiful, but only a few of them are within the reach of Manchester. One of the commonest, the Coltsfoot clustercup, *Æcidium compositarum var tussilaginis*, I have found on the banks of the Mersey, near Northenden, and in great plenty in the Buxton valley as far as Millers Dale, and a score of other localities. *Æ. epilebii* will about this time be in fine condition in the same localities, and generally throughout the country. It appears to be chiefly developed upon *Epilobium hirsuta*, but may be found also on other species of that genus. The beautiful little daisy clustercup *Æ. compositarum, var bellidis*, although very plentiful in some districts in the south of England is very rare in the north, and I have but once succeeded in finding it when at Buxton, rambling on Corbar hill, which over-

looks that charming place. There is another member of this genus which should be looked for now, for it covers a wide range of country and in some districts infests nearly every leaf of the plant. This is *E. compositarum*. *rir taraxaci* upon the well known dandelion. Although so common, generally it is very rare in a wide district surrounding Manchester. I have only twice found it there, on one occasion near Taddington in Derbyshire. The gooseberry clustercup, *E. grossulariae* will be in perfection now, and where it delights to dwell will be in plenty. It is easily seen on the leaves of the tree, and not unfrequently is also found in perfection on the fruit. Occasionally it may be found upon the gooseberries which are brought in the market, and it was one of such gooseberries thus infested which first turned my attention to the study of micro-fungi. There is one other species of this genus which I must not omit to notice, *E. Aviculariae*, which grows upon the smaller knot grass, *Polygonum aviculare*, one of the most common of our weeds. The conditions under which it is developed must be very peculiar, for it is one of the rarest of all the micro-fungi and has seldom been found. I was very fortunate in meeting with it in comparative plenty, on one occasion just outside Manchester, on a heap of rubbish of the most uninviting character. Streets and houses now cover this lucky hunting ground, and I have but little hope of meeting with the plant again, but still I don't neglect this rambling weed as I go along in

my botanical expeditions, and some fine day it may again come to the front.

Amongst the *Aecidiacei* there are several species which form a separate group under the term *Ræstelia*. Of these, which for the most part don't appear until autumn, there is one which is usually met with in June. It is known as *Ræstelia lacerata* or fringed clustercup. It has not the general appearance of the *Aecidiacei*, but has internal characteristics which connect it with that genus. Although comparatively common it does not frequently arrive at perfection in the districts with which I am familiar, for it is only on one occasion that I was fully satisfied with my gatherings. It grows upon the common Hawthorn, both on the leaves and the fruit.

About twelve years ago I met with a leaf-fungus in the Bollin valley, near Wilmslow, Cheshire, which was new to Britain, and not being able to find out what it was I forwarded specimens to Dr. Cooke explaining particulars of locality, &c. The fungus assumed the form of small broken black spots, and the plant upon the leaves of which they were, was the common Butter Bur, or *Petasites vulgaris*. It was a considerable time before the Doctor gave the plant a name, which he did ultimately in *Grevillea*, vol. 1, p. 40, when he named it *Budamia Capsulifer*. Since that time he announced in the same publication, vol. 5, p. 12, that the true name is *Physarum tussilaginis*. Every year about this time

since my first discovery, I have been able to gather any reasonable amount of this fungus in one particular limited district in Cheshire. This district embraces the villages of Wilmslow, Northenden, Gatley, and the valleys in their several localities, and it has been a matter of great astonishment to me that I have never yet heard of any other botanist having found the plant. I have also by means of *Science Gossip* endeavoured to find out if the fungus had been met with elsewhere, but as yet I have no reply. It is one of the species belonging to the *Myxogastres*, and is of especial interest at the present time when some of our scientists are claiming for the genus a relationship with the animal kingdom. I would urge botanical students to be on the look out for this interesting fungus. The probability is that it may be found elsewhere, and it will be strange indeed if Cheshire is the only county in England in which the fungus will grow.

The *Pucciniæi* are beginning to be plentiful now, and are most of them very conspicuous by their intense blackness. There is no difficulty in recognising them under the microscope, for they are all composed of two small cells. It is true the cells vary considerably in size, form, and other particulars, some have peduncles or stalks of various lengths, &c., and it is such variations upon which species are determined. The external appearances and habits of the plant also vary considerably. In many cases you find the fungus in minute

spots, scattering irregularly and in plenty, on the leaf as in *Puccinia compositarum*, on *Centauria*, and many other plants. In other cases as in *P. Smyrnii* there are but a very few such spots, and the fungus is very likely to be overlooked. Then we have *P. umbilici* where the fungus when fully ripe assumes the form of a dark (almost black) patch. In the case of *P. anemone* on the *Wood anemone*, we have the black spots of the fungus arranged artistically so as to give beauty to the leaf. In the fungus on the Betany, *P. betonicæ* we have a different habit again, the brown spores of the fungus in small quantity first come upon the surface of the leaf by bursting the cuticle, and in the end when the fungus has arrived at perfect maturity, the entire leaf is covered with the smut. Thus the student by the external appearance of the fungus may soon find out the means of identification. The whole of the *Puccinia* I have named above have been gathered in June. Besides them there are numerous other leaf-fungi to be met with now, but most of them will linger on till next month, when we may make their acquaintance and introduce them to the reader.





JULY.

IT must be understood, as I have previously intimated, that any enumeration of leaf-fungi as belonging to any particular month must be accepted as merely a convenient mode of conveying to the student what he should look for as most likely to be found. Nature does not accept any such limitations, and is only influenced by local conditions and by climate. For instance, the brand upon the *Adoxa muscata* I have usually classed with the fungi for June, and it is now in July in perfection, it is known as *Puccinia saxifragarum*. Similar circumstances arise continually in every attempt at classification as to time.

I referred in the May paper to the genus *Trichobasis*. There are now various species of the genus to be met with, some, as the *T. violorum*, on the field violets, are very common, as is also *T. cichoracearum* on the composite plants. Various other species also may now be met with, and are easily known and identified on microscopic examination. There are numerous *Eeidiacei*

now to be met with, the one on garden mint as also on wild mint is very common; the same clustercup *Æ. menthae* is found upon both, but is much more common on the garden mint than the wild. It grows chiefly upon the stalks, but occasionally it is to be found upon the leaves. There is one other clustercup of rare beauty which I have found this month, *Æ. behenis*, or Bladder-campion clustercup. This fungus is rare as it is beautiful, and I have only found it twice, once in Wales and once in Devonshire, and in both cases on the sea coast.

Amongst the white micro-fungi, for we have them of all colours, there is one which I hunted for during almost a generation, and I have never met with in the north of England. It is *Cystopus candidus* on cabbage. I did, however, meet with it in Devonshire, in 1879, and in the following autumn at Deganway, near Conway in Wales. Strange to say there is the exactly same species of fungus which grows upon the Shepherds' Purse (*Capsella bursa-pastoris*) in great plenty almost everywhere. At certain times the plant and the fungus are alike common. There are other species of this genus which will often be met with by the industrious student, one of which is rarely found in perfection or in any considerable quantity. I allude to the Goat's beard *cystopus*, known as *Cystopus cubicus*, or Goat's beard white rust. This I have found in small quantity near Southport on many occasions, but I don't imagine that

it is ever developed in large quantity. On cabbage, when *cystopus* is found on that plant, it appears in patches often comparatively large, and they have the appearance of dabs of whitewash.

There is another genus to which I desire to refer, although several of the species are, from their surrounding conditions, difficult to meet with. Others cannot well be overlooked. Amongst the latter are *Tilletia caries*, the bunt of wheat, and *Ustilago carbo*, corn smut, so common on oats and barley. Amongst the more minute species are those that grow upon the anthers of various flowers. *Ustilago Antherarum* I have but once found; it was when I was botanizing in Dovedale some years ago; it was on *Silene inflata*. In the summer of 1880, I for the first time met with *Ustilago Kuehniana* at Urmston on anthers of common *Sorrel*, *Rumex acetosa*. *Ustilago longissima* on grass I have frequently met with, but only in one locality, near Northenden in Cheshire; but I don't suppose the smut is confined to any county whatever. When seen upon the leaf it wears the appearance of fine black lines as if ruled with a pen. There are various other species on grass, as also on numerous plants, and they are all worthy of being sought after by the reader.

These very minute organisms require a good lens of high power, and also of good defining quality, in order to distinguish the different species. I have often employed one of Beck and Beck's one sixth for this

purpose, and even then I have had to go over the specimen frequently before I could come to any satisfactory conclusion.

Now is the time to begin to look out for *Peronospora*. They generally assume the form of delicate white threads thickly set upon the leaf of the plant, giving it a somewhat glazed appearance. One of this genus is the great enemy of our favourite vegetable the potatoe, and is the especial dread of the market gardener. If the season be wet, this well-known mould *Peronospora infestans*, as it is named, is very likely to be developed towards the latter end of this month, or early in the next. A preliminary decay of the leaf is indicated by the appearance of brownish spots, and on the examination of the leaf in this condition, the mould, if existing, will be found close to, and sometimes partly upon the spots. Unfortunately this pest is far too common amongst potatoe fields in wet seasons. In August, 1880, I met with an enormous quantity of the fungus in potatoe fields at Urmston, and, had not the farmers took the wise step of at once digging up the tubers, the destruction would have been fearful. Thoughtless delay in the farmer frequently gives the fungus time to get down to the potatoe itself, when the tuber quickly becomes unfit for human food. The way by which this rapid change comes about, is a good study for the microscopist, but is too long a story for me to tell on the present occasion. The species of this genus are numerous,

and new ones are frequently being found ; some ten or a dozen such are well recognised and admitted as true *Peronospora* that were not known a dozen years ago. The Rev. Mr. Vize, of Forden, Welshpool, has the honour of bringing some of these to the knowledge of botanical students. If the reader desires, he may soon collect a considerable number of the *Peronospora*, for they are constant visitors upon a large number of our plants. Our old friend *Ranunculus ficaria*, which has already given us a beautiful clustercup *Aecidium ranunculacearum*, and the smut *Uromyces ficariae* supplies us with a *Peronospora*, *P. ficariae*. The wood anemone also gives us a clustercup, *Aecidium leucospermum*, and a smut *Puccinia anemones* now presents us with the *Peronospora pygmaea*. In this way numerous plants during the year come forward from time to time with their contributions for scientific study. I think I can now best assist the student by giving a list of the more common *Peronospora*, a familiarity with which will tend to educate the eye, and prepare him for the discovery and identification of the more rare ones. The more common ones, speaking from my own experience, are :—

Peronospora nivea (Parsnip mould), on *Umbelliferæ*.

P. gangliformis (Lettuce mould), on Lettuces and other *compositæ*.

P. viciae (Pea mould), on Peas, &c.

P. violæ (Violet mould), on leaves of common Violet.

? *urticæ* (Nettle mould), on leaves of Nettle.
P. obliqua (Dock mould), on leaves of Sorrel and Dock.

Amonst the *Æcidiales* we have several interesting fungi, known as *Peridermiums*, one of which *Peridermium pini* may be found this month on leaves of Scotch fir. I cannot but think it very rare, as I have never been able to meet with it, although my attempts in that direction have been continued from year to year ever since my study of these wonderful plants began. Let the student, however, take such opportunities as he may have for the examination of the tree, and it is not improbable that he may be more fortunate than the writer.





AUGUST.

CERTAIN members of the interesting group of micro-fungi, known as *Pucciniæ*, have had our attention in previous papers as they have been gradually coming to the front. Now we have them in great plenty. The straw stalks of wheat and the leaves of wheat, as also certain grasses, are frequently infested with a member of the group known as *Puccinia graminis*, the spores of which, like those of other *Puccinia* proper, are two celled, but they are larger and much longer than most if not all other members of the group, and possess a lengthened stalk or peduncle. Garden mint is now likely to develop a *Puccinia*, for I have found it yearly during some eight or ten years about this time in a neighbour's garden, on the outskirts of Manchester and elsewhere. This smut *Puccinia menthae* is also found on wild mint and other plants, but it is more rare on the wild than the garden

mint. *P. glomerata* is to be found on the ragwort now, and will continue with us almost to the end of the year. It must, I think, be very common, for I have met with it so frequently round about Manchester as also far away from that city. The species of ragwort, *Senecio Jacobaea*, on which I have usually found the smut, is one of our most common wild plants.

Puccinia variabilis, which infests that common weed the dandelion, claims our special attention from the circumstance of the strange variations which exist in the forms of its spores. Some are rounded, others stunted or variously elongated, while occasionally they are formed of three cells, whereas the common characteristic of *Puccinia* is that they are two celled. It is but seldom that I have met with this singular variation of three cells from the normal condition of the spores. In some portions of the country the fungus is very common, and I have found almost every leaf infested, in others it is very rare, if ever met with. This is the case in Lancashire and Cheshire so far as my experience goes.

Belonging the *Pucciniae* there are several species of another group of leaf-fungi which have a special claim upon our attention. I allude to those known as *Phragmidiums*. They may all be met with about this time, but some in favourable localities will have appeared earlier, while others will linger on even a month or two longer. Instead of being two celled like the *Puccinia*, they are made up of three, four, five, or in some

instances six cells, thus forming a small string of cells. Upon the leaves of plants where they grow they assume an aggregated appearance and form tufts, and well dried and mounted in this condition as opaque objects make most charming slides for the microscope. The whole of the group have peduncles or stalks of attachment to the leaves upon which they grow, and as they are not numerous I will refer to the whole of the known British species.

The most conspicuous of the group is the bramble brand, *Phragmidium bulbosum*, and it is very common over a large extent of country, especially in Wales and the Lake District. In other localities I have met with it—as for example—in Cheshire and Derbyshire, but in these cases always in smaller quantity. The *P. bulbosum* I have found as late as October on one occasion, as also I, on the same occasion, met with raspberry brand—*Phragmidium gracile*. In these two instances the plants were in fair condition, although the season was so far gone. The raspberry brand is a smaller fungus than the bramble brand, and the reader will find the distinction most marked, besides the leaves of the two plants at once determine the question. The leaf of the bramble is prickly and of a coarser structure than the leaf of the raspberry.

The Rose brand, *Phragmidium mucronatum*, is not so common as the two other brands I have already named, but still it cannot be called scarce, for in

favourable localities it is plentiful. In the open country at the proper time it may be found by the student upon the leaves of the common dog rose. The best find I ever made of this *Phragmidium* was near Southport some ten years ago about this time. I have met with it frequently elsewhere, but never upon the cultivated or garden rose.

The Strawberry brand, *Phragmidium obtusum*, and the Burnet brand, *Phragmidium acuminatum*, are both somewhat smaller fungi than those previously named. The first is found on the leaves of the wild strawberry plant. I have met with it on two occasions in moderate quantity, but I am inclined to think it rare. One occasion was when I was at Aberystwith, and the other within about a mile of the sea coast in the Lake District. The *P. acuminatum* is a still rarer fungus, and when found upon the leaf of the burnet is generally in small quantity, and very likely to be overlooked by the student. It is in a case of this kind that a good pocket lens is extremely useful. We have another member of this group named by Dr. Cooke, *Phragmidium bullatum*. This fungus is said to grow upon the twigs of the dog rose, but as yet I have not had the good fortune to meet with it.

I have just spoken of *Phragmidium acuminatum* as growing upon the burnet. It should however be remembered that it is the smaller burnet, *Poterium sanguisorba*, upon which the fungus grows, for we

have a larger burnet, *Sanguisorba officinalis*, and this also furnishes us with an interesting brand—I allude to the charming chain brand, *Xenodochus carbonarius*. This is one of the most pleasing and interesting of all the leaf-fungi, and is said by Dr. Cooke to be very rare. Notwithstanding this opinion of the Doctor, I have to say for the encouragement of the reader that I find it every summer in plenty. My chief gatherings have been in the Buxton valley some two or three miles from the town. I can any summer find it also in Cheshire in the valley of the Bollin in fields near the river. I have received it from Montgomeryshire, and I doubt not it may be found in numerous localities. The brand has the general characteristics of a *Phragmidium*, but it is greatly extended in length, and forms a beautiful chain as of beads, a sort of fairy necklace. Besides this there is still a smaller chain brand, I allude to *Xenodochus curtus*, which has never been found but once when the writer had the good fortune to meet with it in September, 1873. Specimens of the fungus were forwarded to Dr. Cooke, and he has in the later editions of his work, "Rust, Smut, Mildew, and Mould," given a full description of the plant to which I beg to refer the reader. The plant upon which it was found is *Valeriana officinalis*, and it will give me pleasure if I can hear of other students meeting with this very rare fungus. For the information of the reader, I will explain the locality in which I met with it. On the high road from Buxton

Bakewell there is the village of Taddington, about equal distance betwixt the two places. Going in the direction of Bakewell from Taddington and about a mile from the village is a wood on the left hand or eastern side of the road. It was in this wood and not many yards from the road that I found *Xenodochus curtus*. I have made many efforts since my discovery to find more of the fungus, but I regret to say always without success.

The reader will find August a favourable month for gathering another curious group of leaf-fungi, known as *Erysiphe*. The general structure and physiology of these fungi differ greatly from all others that have claimed our attention. Their appearance as seen on the leaves of the plants upon which they grow is that of small cannon balls, and they are most difficult to find on account of their extreme minuteness. The one on the burdock—burdock blight, *Erysiphe montagnei*, is I think the best to find on account of the large quantity and comparative largeness of the fungus. Whenever the reader meets with the leaves of the burdock in a decayed condition, he will most probably find such leaves infested with the fungus in an unmistakable manner. The mugwort is infested with a much smaller fungus, *Erysiphe Linkii*. This I have found in numerous localities in Lancashire and Cheshire, and I have reason to look upon it as common. We have one member of this group on peas and beans and various other plants. It is known as *Erysiphe Martii*, and is

very common in autumn. Besides those I have already named we have Grass Blight, *Erysiphe graminis*; we have the Composite Blight, *Erysiphe lamprocarpa*, on plantain, and sundry other plants; we have the Buttercup Blight, *Erysiphe communis*, and the Bugloss Blight, *Erysyphe horridula*, and lastly Cornel Blight, *Erysiphe tortilis*. The last, which is to be found upon the leaves of the dogwood, *Cornus sanguinea*, I have met with but once. Still I don't think it scarce, but its extreme minuteness makes it difficult to find. One peculiarity of this group of fungi is that they are surrounded with singular radiating appendages, an idea of the general characteristics of which may be gathered from the figure on Plate No. 1. Another is that the spores of the fungus are developed in a sort of pod called an ascus, each ascus containing two spores. If the student desires to see the spores in ascus he should take one or more of the parasites from the leaf, place them in water and burst them by pressure when under the microscope, when he cannot well fail to find what he is looking for, as also the remarkable appendages connected with the parasite.





SEPTEMBER.

THE autumn of the year is the great harvest of the student who pays especial attention to micro-fungi. It is then that the leaves of trees, and vegetation generally, begin to decay under the blighting influence of a lower temperature, and as they lose their vitality they become the abodes of a new vegetable kingdom, which may not improperly be called the invisible kingdom, for so far as the world generally is concerned, it is altogether unknown and uncared for. With the decay of ordinary vegetation we lose one of the most lovely aspects of nature, but to the microscopist this is not altogether a loss; there is a happy compensation for him in the marvellous wonders he finds in the new world brought into existence by the decay of the old. In the earlier portions of the year the micro-fungi he was able to find were upon healthy, perfect leaves, and comparatively few; now their number is legion, and they are found on dead and dying vegetation

all around him wherever he may care to look for them. It would be vain in me to attempt to refer to all the numerous species which now make their appearance: the catalogue would be far too long for this short article, so I must confine myself chiefly to the notice of what I have myself met with in my rambles, or such as I have come upon unexpectedly. Still, as almost every locality is the home of special plants, microscopic or otherwise, it may be well to refer to such micro-fungi as may be easily recognised by the student.

By this time most of the Uredos are over, the one on the larger burnet still lingering on in connection with the beautiful chain-brand referred to in the last number for August, but several others have come to the front, amongst them *Uredo quercus*. On the underside of oak leaf this has been found in Sherwood forest and elsewhere, but I have never heard of it being found near to any of our large towns. The same remarks will apply to the bilberry fungus, *Uredo vacciniorum*, which is a native of the mountains or the moors. The fern uredo, or *Uredo filicium*, I have met with frequently on *Cystopteris fragilis*, but I still believe it is rare, as I cannot hear of others finding it. I have a specimen on *Scolopendrium vulgare* which was supplied me by a friend.

Amongst what may be termed the autumnal Uredos is one on the Enchanter's Nightshade, *Circæ lutetiana*. This I once met with in beautiful condition in a wood at

Matlock. The wood is on the left bank of the river Derwent, which has to be crossed by a boat. There is a remarkable circumstance connected with all these later Uredos, namely, that the spores are extremely minute. If the student will be at the trouble of comparing the spores of *Uredo miniata*, or any of the earlier species, with the spores of any autumnal kind, he will at once recognise the great difference.

Many of the fungi referred to in last month's paper are still to be found, especially *Erysiphe montagnii* and *E. Linkii*. Last year I found these in great plenty as late as October. It is only when the plants on which they live have been destroyed by the frost that they altogether disappear.

Amongst *Pucciniae* named in former papers, some are over, but many remain to reward the botanist, and amongst them are many that I have not previously referred to; amongst them *Puccinia polygonorum*. This I have never met with in good condition but once, and that was so far back as the autumn of 1863, now eighteen years ago. *Puccinia Galiorum*, Bedstraw brand, on *Galium aparine* should be looked for now and also in October, as I found it last year in the latter month. The asparagus brand, *P. asparagi*, may now be met with. I have once found it when stopping at Ashford-in-the-Water, near Bakewell. The Iris *Puccinia*, and others named by Dr. Cooke, I have never yet been able to find.

In looking over my own gatherings of micro-fungi I have frequently been reminded of the fact that a considerable number of them I have met with but once, while others come to the front every year as regularly and as plentifully as daisies or buttercups. Some that I once thought very rare I now find frequently, and some others that I felt inclined to think common I have never met with. Probably this also may be the experience of other students. The only wise plan of research is for the student to look out everywhere whenever an opportunity arises in both likely and unlikely places, and he will not unfrequently be rewarded by finding in the latter unexpected treasures, which will amply repay him for any trouble he may have taken.





OCTOBER.

DURING this month, and onwards during the year, the Nidulariacei may be found, and are well worth the looking for. They are not leaf-fungi of which I have hitherto spoken, but one species, *Thelebolus terrestris* may be found upon fir leaves. The dying or dead stems of ferns, especially of *Pteris aquilina*, are the habitats of many of them; others may be found on dead twigs lying on the ground, or in other similar situations. Many of them are in appearance like small birds' nests, hence the name of Nidulariacei. In one species, *Crucibulum vulgare*, there are from four to six of these egg-like bodies on an average in each nest about the size of a moderate-sized pin's head. If one of these egg-like bodies be softened in water and broken up, it will be found to contain thousands of oval transparent spores. Although I have bestowed much trouble in looking for these curious plants, I have only met with a few of them. *Cyathus vernicosus* I found at Broughton-in-Furness in August, 1875; and *Spherobolus*

stellatus in October of the same year at Marple. It will be observed that the fungi referred to are comparatively large, and may be readily recognised if the student is fortunate enough to meet with them. Some of them will measure from quarter of an inch to half an inch or more in diameter. There are many species of Ascobolus, which belong to the Elvellacei, now to be met with, and they are easily recognised. Numerous of them are of a bright orange or yellow colour, and grow upon cow-dung. They may be found in almost every pasture where cows feed. The fruit of the Ascobolus, when well mounted, forms one of the most beautiful of microscopic objects. The spores are in countless numbers of pod-like cases called asci, and are very transparent. They should be mounted in jelly or fluid. After many trials, I have been compelled to give up Canada balsam as a medium for these objects.

Besides the above so easily found there are numerous other species which require carefully looking for: some are black, some green, and others of various shades. A many of them are very small. By far the larger number of the species are to be found upon the dung of animals—the cow, horse, rabbit, sheep, and others furnish numerous species. Some have been found upon leather and old rags, but I must not occupy the space necessary for a fuller account of these interesting fungi. I will only add that they may be found anywhere in the proper season. Some of the species may be met with

all the year round. At the present time cow-dung is the favourite nidus upon which several species grow in great abundance.

Some of the Myxogastres (a most interesting family, and a great puzzle to the science student) come to the front about this time, while others of them are over, and will not appear again until spring. *Physarum album* is a very interesting member of the family. Damp shady places, especially woods, should be explored in search of it. It may be found on various substances. My most pleasing specimen I found on leaves of ground ivy in October of last year. Other species may be found on dead branches of trees lying on the ground or on rotten wood.

Various species of *Arcyria* (they also belong to the Myxogastres) may now be met with on rotten wood, or on moss in damp places. They are exceedingly beautiful microscopic objects, and are comparatively common. The *Arcyria punicea*, the common name of which is "Splendid Arcyria," does truly merit that name. It is of a rich red colour, about the size of a large pin's head. and clusters of the fungus are usually found together. There are other members of the family that will be met with by the diligent student, but I name this one specially, as it is of all of them the most easily found in consequence of its bright colour.

The Trichia (also Myxogastres) are now to be met with. They also are found on rotten wood. One of

them, *Trichia rubiformis*, is readily seen by its bright red colour, and is here known commonly as "Reddish Trichia." There are numerous species of the Trichia, almost all on rotten wood. During the month, and indeed during the winter, the forest, where dead sticks are scattered about, and dead stumps, in various conditions of rottenness may be met with, forms a rich hunting ground for the student. Not only are the above rich in minute fungi, but the thousands of leaves spread about under his feet are almost all more or less covered with minute cryptogams. I have rambled miles among such scenes of dead vegetation, where I have found an infinity of life springing up from the ashes of the dead. Organisms, wonderful in their structure, rich in colour, and when seen under the lens of a good microscope, as beautiful as the loved flowers of the spring. The admirer of the common wild flowers finds his special botanical enjoyment gone as winter approaches, but it is not so with the microscopist; for him nature provides a perpetual feast. No frost or storm can deprive him of his plants. The enjoyment when he meets with them is untold, and in due time they are placed in his cabinet, and become things of beauty for ever.

I have once met with *Xenodochus carbonarius* as late as October, as also various members of the same genus; indeed, there are a goodly number of leaf-fungi still to be found. Sheltered warm corners amongst rocks are likely places to find late specimens of micro-

fungi ; indeed, the thoughtful student will not overlook such promising localities. I abstain from giving a technical description of the fungi I have referred to, as I believe the small space I can occupy is better employed in indicating to the student what to look for, and the most likely places to find what he wants. Structure is best understood by personal examination with a microscope.

I will close this paper by a reference to the Diachæa. The one species—for there is but one—belongs to the Myxogastres, and may be found when the special conditions exist all the year round. It is not so common as the other fungi I have spoken of. It grows in small tufts aggregated, and about the size of the Arcyria, but there is no beauty of colour to attract the eye, for it is perfectly black. The structure of the fungus is very beautiful, and very similar to the structure of the Arcyria. I have found this fungus but once, and that was some years ago, in a cucumber frame, upon a bit of very rotten wood. The fungus, I am inclined to think, is not very rare, but its blackness and small size prevent its being seen.





NOVEMBER.

AS November approaches the leaf-fungi have with but few exceptions withdrawn from the scene, but other minute members of the great fungus family crowd upon us and claim our attention. The innumerable leaves, lately green or beautifully tinted with autumnal shades, are now scattered about in all directions. The vegetable vitality is extinct, but the dead leaf becomes the home of countless organisms. In its gradual decomposition it brings into life a new world of interesting plants, all deserving of microscopic study. There is nothing upon the leaf to indicate the existence of the former leaf-fungi except an opening or fracture in the leaf itself. The leaf tissue has in part been consumed by the parasite, and the millions of spores have been wafted away by the wind to find a resting place until another summer, when they may originate a renewed life. Now there is no scarcity of fallen leaves, for country lanes and woody districts are paved with them. If we pick up a few we soon discover

a marked difference in their surface appearance. Some have distinct black patches upon them, the marks of a decided fungus, while others have but microscopic hints of the possibility of organic life. The patches I speak of are sometimes so arranged upon the leaf of the sycamore as to form a beautiful artistic pattern; at other times irregularly broken up into large and small patches. In all cases they are intensely black and have a shining undulating surface so that they are easily recognised. The black patches on the sycamore are caused by a fungus known as *Rhytisma acerinum*, and may be met with in woods every autumn in great quantity. I shall never forget my first find of this well-known fungus in a wood at Chelford, early in my microscopic study. Since then, I have frequently met with it. Willow leaves furnish us with another *Rhytisma*, *R. salicinum*, and the nettle another, *R. urticae*, but these, although easily seen, are not so conspicuous as *R. acerinum*. There is one other to which I must refer, namely, *Rhytisma maximum*, which makes its home upon branches of the willow, and when in good condition is a most interesting object. Then the spores in ascii may be easily obtained and prepared for microscopic inspection. I have always been more or less disappointed in the examination of other *Rhytisma*, but never with this. It may be known by its shining surface, but the dimpled characteristic of other *Rhytisma* is absent.

The genus *Dothidea* should now be looked for. Various of them have made their appearance earlier, but may linger on to the end of the year. The one on the rush, *D. junci*, is an annual visitor, and may now be met with on the margins of pools where rushes love to grow. Another, which is very common, is *D. filicina*, bracken *Dothidea*. Almost every stem of *Pteris aquilina* is more or less infested with this fungus. Some of the *Dothidea* grow on decayed herbaceous stems, as *D. striiformis*. Gooseberry branches are sometimes infested with *Dothidea ribesia*. Other plants become the homes of other *Dothidea*, but it is not desirable that I should occupy more time with this genus.

The Phaciacei, of which there are numerous species, and some of which may be easily found on dead leaves. On the holly leaves two species are frequently met with. In woods where the holly is plentiful, the dead leaves of the trees in winter are scattered about in thousands, and almost every leaf is beautifully spotted over with the conspicuous black fungus. The two species I refer to are *Phacidium ilicis* and *P. ilicis pulveracea*.

Leaves of other plants, now dead on the ground, are equally the habitats of members of this family. What I have said must be accepted as an indication of an interesting field of research to the student.

There is a small, bright yellow or orange fungus to be found on damp old twigs and stumps in the shape of

rounded spots. After a long continuance of wet weather this is so abundant at times that it cannot be well overlooked, and more especially about this season. It is *Tubercularia vulgaris*. It is also found on dead twigs upon the living tree. I have many times found it thus in Hough End Clough, within about a mile from Alexandra Park, Manchester. If examined, it is found to consist almost entirely of a mass of countless conidia. I have found November the best time to look for this fungus, and when I have set out on an expedition for that purpose I have never failed to secure what I wanted. This fungus is, however, but the early condition of a more interesting plant, known as *Nectria cinnabrina*, in its perfect condition, and I have sometimes found it when the two conditions could be distinctly seen on the same stem, and when the change from the early state of the fungus to its perfect condition was taking place. I have at present specimens in my herbarium of that character by me which I obtained some years ago.

The *Nectria* belong to the Sphaeriacei, as also do the Dothidea, spoken of above, having spores in asci, and it requires a good lens to define them well. A fourth or a sixth is the most suitable power for the purpose.

The industrious student will meet with numerous other micro-fungi during the month equally interesting with those to which I have referred, but I have said

enough to point out the vast field of research which lies before him, and I hope I have also said sufficient to stimulate his industry in the pursuit of a study, than which none is more delightful, nor does any provide for him a more ample reward.



ENQUIRIES
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DECEMBER.

THOSE who have done me the honour of reading my notes from month to month during the year, will remember that we began the notice of leaf-fungi in the early spring, when they first came to gladden our eyes upon *Ranunculus ficaria*, generally known as Pilewort or the lesser Celandine. This early visitor of our meadows, with its two interesting micro-fungi upon its leaves, is the harbinger of a complete host of followers of equal or surpassing interest and beauty. Year by year with unfailing fidelity this welcome plant with its shining golden petals comes to the front thus early to cheer the botanist, and to re-call to the student of microscopy the large harvest of scientific study which is in preparation for him. Thus early we have but two species of leaf-fungi, but soon others are developed in great number almost daily, until a large proportion of the vegetable kingdom becomes decorated or infested with these minute

cryptogams—sometimes the pest of the agriculturist; but always the delight of the botanical microscopist, as also for him the best field for studying the secrets of nature. If there be a link connecting the animal and vegetable kingdoms, here it is that that link must be sought for, and the tendency of scientific research indicates that here it is where such link must be found. The thinkers of the day who earnestly seek to solve this hidden problem are all directing their studies towards certain members of this numerous family for a decided reply and demonstration on the subject. I fear to attempt a forecast of what the result may be. My desire is not to give an opinion on the difficult question, but to call the attention of the student to the subject as one of infinite interest and well deserving of his careful study.

From month to month since March the leaf-fungi have kept us company in continually increasing numbers, until the deadening chills of autumn began to thin their ranks, and from that time they have left the field gradually until but few remain. Still there are two or three who keep up the fight for existence, and it is always a real pleasure to the microscopical student when he meets with these old favourites who remain to cast a bit of botanical sunshine on the dark days of winter. In this otherwise cold and dreary month there are sometimes bright days when the botanist will be off into the meadows hunting in sheltered nooks for

sundry cryptogams, when his eye may rest upon the well-known smut upon the ragwort. This vigorous plant with its black spots of *Puccinia* comes into life early in the year and maintains a prolonged existence near unto the merry days of Christmas festivity. The only locality where I have found the fungus *Puccinia glomerata* so late as about this time is near to Southport. Betwixt this place and Churchtown there are countless sandy hills and sundry sandy lanes, and amongst them many warm sheltered corners where more than one summer plant lingers on into the short dark days of winter. It is in such places where the botanical hunter should peep, for there he may find unexpected prey. There are two other leaf-fungi which I have met with in December, but in these cases I had to go far away south into the charming and mild county of Devon. There in this month in 1873 I found the Ground Ivy Brand, *Puccinia glechomatis*, on *Glecoma hederacea*, within about a hundred yards of the railroad station at Taunton. The other Devonshire fungus I refer to I met with in a pleasant ramble betwixt Barnstaple and Ilfracombe. It was in a sheltered valley well protected by surrounding hills. The plant upon which I found this third December fungus was upon the *Cotyledon Umbilicus*, and is known as *Puccinia Umbilici*. This I also found in 1873. Doubtless the short days of this month, with the not unfrequent accompaniments of snow and rain make botanical hunting not very inviting,

Still something may be got worth gathering, for a handful of dead leaves picked up from the earth are certain to be covered more or less with vegetable organisms. When by the comfortable fireside in the long winter nights even these dead leaves will find the student profitable and pleasureable employment.

In reviewing the notes of the year I meet with a complete host of interesting fungi which I could not well introduce to the reader. This is the result of an absolute necessity, as my space and my time have been alike limited. I have desired to be a guide and a help to the young beginner, and now I have to bid him farewell with a hearty wish that he may go on his way rejoicing. It has been a pleasure to me to have been employed in this humble duty, and I have a further satisfaction in believing that my labour has not been in vain.

THOMAS BRITTAINE.





APPENDIX.

Containing a list of Micro-fungi mostly to be found
on leaves of plants.

Ræstelia lacerata (Lacerated Ræstelia), on hawthorn.

Ræstelia cornuta (Horn-like Ræstelia), on mountain ash.

Ræstelia cancellata (Pear-leaf Ræstelia), on pear leaves.

Periderium elatinum, on silver fir.

Periderium pini, on young Scotch fir.

Periderium columnare, on *picea*.

Periderium acilocum, on leaves of Scotch fir.

Æcidium tragopogonis (Goat's beard Clustercups), on
goat's beard.

Æcidium depauperans (Violet Clustercups), on garden
violets.

Æcidium epilobii (Willow-herb Clustercups), on
Epilobium hirsutum and E. montana.

Æcidium quadrifidium (Four-lobed Clustercups), on
garden anemone.

Æcidium leucospermum (White-spored Clustercups), on
wood anemone.

Æcidium albescens (Moschatel Clustercups), on adoxa
moschatellina.

Æcidium thesii (Bastard Toadflax Clustercups), on
thesium humifusum.

Æcidium Soldanellæ (Soldanella Clustercups), on
soldanilla Alpina.

Æcidium euphorbiæ (Spurge Clustercups), on spurge leaves

Æcidium thalictri (Meadow-rue Clustercups), on thalic-
trum alpinum.

Æcidium berberidis (Berberry Clustercups), on leaves of
berberry.

Æcidium statices (Sea-lavender Clustercups), on silene
inflata.

Æcidium grossulariæ (Gooseberry Clustercups), on leaves
and fruit of gooseberry.

Æcidium valerianacearum (Valerian Clustercups), on
valeriana officinalis.

Æcidium bunii (Pig-nut Clustercups), on umbilifera.

Æcidium ranunculacearum (Crowfoot Clustercups), on
ranunculas ficaria.

Æcidium periclymene (Honeysuckle Clustercups), under
the leaves of honeysuckle.

Æcidium crassum (Buckthorn Clustercups), on rhamnus
catharticus.

Æcidium calthæ (Marsh Marigold Clustercups), on
caltha palustris.

Æcidium galii (Bed-straw Clustercups), on galium
verum, &c.

Æcidium pimpinellæ (Pimpinella Clustercups), on
pimpinella saxifraga.

Æcidium asperifolii (Borage Clustercups), on boragineæ.

Æcidium urticæ (Nettle Clustercups), on the leaves and
stalks of nettle.

Æcidium orobi (Bitter-vetch Clustercups), on orobus
tuberous.

Æcidium compositarum (var Lapsana), on lapsana
communis.

Æcidium compositarum (var Taraxaci) on dandelion.

Æcidium compositarum (var Jacobæa), on senecio
jacobœa.

Æcidium compositarum (var Prenanthis), on hawkweed.

Æcidium compositarum (var Tussilaginis), on Coltsfoot.

Æcidium saniculæ (Sanicle Clustercups), on salinula Europœa.

Æcidium poterii (Burnet Clustercups), on poterium sanguisorba.

Æcidium menthæ (Mint Clustercups), on garden and other mints.

Æcidium pedicularis (Red-rattle Clustercups), on pedicularis palustris.

Æcidium rubellum (Dock Clustercups), on sorrel and dock.

Æcidium ari (Wake-robin Clustercups), on arum maculatum.

Æcidium violæ (Violet Clustercups), on wild violets.

Æcidium geranii (Crane's bill Clustercups), on geranium pratense, &c.

Æcidium scrophulariæ (Figwort Clustercups), on scrophularea aquatica.

Æcidium primulæ (Primrose Clustercups), on leaves of primroses.

Æcidium aviculariæ (Knot-grass Clustercups), on polygonum aviculare.

Æcidium dracontii (Arum Clustercups), on garden arum triphyllum.

Æcidium incarceratum, on sagittaria.

Æcidium orchidearum (Orchis Clustercups), on leaves of orchis latifolia.

Æcidium alii (Garlic Clustercups), on leaves of common garlic.

Xenodochus carbonarius (Burnet Chain Brand), on the larger burnet.

Xenodochus curtus, on valeriana officinalis.

Phragmidium gracile (Raspberry Brand), on leaves of raspberry.

Phragmidium acuminatum (Burnet Brand), on the lesser burnet.

Phragmidium bulbosum (Bramble Brand), on leaves of bramble.

Phragmidium mucronatum (Rose Brand), on leaves of dog rose.

Phragmidium bullatum, on dog rose twigs.

Puccinia striola (Sedge Mildew), on sedges and rushes.

Puccinia asparagi (Asparagus Brand), on dead stems of asparagus.

Puccinia molinæ (Molinia Brand), on molinea cerulea.

Puccinia coronata (Crowned Puccinia), on grasses.

Puccinia arundinacea (Reed Brand), on reeds.

Puccinia graminis (Corn Mildew or Brand), on leaves
of corn or grass.

Puccinia straminis, on wheat, rye, &c.

Puccinia liniaris, on phalaris arundinacea.

Puccinia luzulæ (Luzula Brand), on luzula.

Puccinia truncata (Iris Brand), on Iris fætidissima.

Puccinia polygonorum (Polygonum Brand). on
polygonum.

Puccinia clandestina (Scabius Brand), on scabiosa succisa

Puccinia campanulæ (Campanula Brand), on campanula.

Puccinia betonicæ (Betony Brand), on stachys
betonica.

Puccinia clinopodii, on clinopodium.

Puccinia menthæ (Mint Brand), on various mints.

Puccinia veronicarum (Veronica Brand), on veronica.

Puccinia thesii (Bastard-toadflax Brand), on thesium
humifusam.

Puccinia amphibii, on polyginum amphibium.

Puccinia vaginalium (Knotgrass Brand), on polyginum
aviculare.

Puccinia bistortæ, on leaves of polyganum viviparum.

Puccinium primulæ (Primrose Brand), on primrose leaves

Puccinia glechomatis (Ground-ivy Brand), on glechomata
hederacea.

Puccinia scorodiniæ (Woodsage Brand), on leaves of
woodsage.

Puccinia malvacearum, on mallow and hollyock leaves.

Puccinia vincæ (Perrywinkle Brand) on vinca major.

Puccinia valentiæ (Crosswort Brand), on galium
cruciatum.

Puccinia variabilis (Variable Brand), on dandelion.

Puccinia hieracii, on pieris, &c.

Puccinia tanaceti, on tanacetum vulgare.

Puccinia tripolii, on aster tripoliam.

Puccinia cirsii (Scattered-thistle Brand), on leaves of
cirsium.

Puccinia glomerata (Ragwort Brand). on senecia
Jacobæa.

Puccinia discoidearum (Southern-wood Brand), on
artemisia maritima.

Puccinia syngenesiarum (Thistle Brand), on leaves of
thistle.

Puccinia vergaureæ (Golden-rod Brand), on solidago
vargaurea..

Puccinia Andersoni, on *enicus heterophyllus*.

Puccinia lapsana, on *lapsana communis*.

Puccinia centaureæ, on *centaurea*.

Puccinia millifolii, on *achillea millifolium*.

Puccinia senecionis, on *senecio aquatica*.

Puccinia galiorum (Bedstraw Brand), on *galium*, &c.

Puccinia acuminata, on *galum saxatile*.

Puccinia heraclei (Hog-weed Brand), on *heraclium*.

Puccinia Ægopodii (Gout-weed Brand), on *ægopodium podagraria*.

Puccinia saniculæ (Sanicle Brand), on *sanicula Europæa*.

Puccinia pimpinellæ, on *pimpinella saxifraga*.

Puccinia conii (Hemlock Brand), on certain *umbellifera*.

Puccinia anemones (Anemone Brand), on wood anemone.

Puccinia saxifragarum (Saxifrage Brand), on *saxifraga granulata*.

Puccinia difformis (Goosegrass Brand), on *galium aparine*.

Puccinium umbelliferarum (Pignut Brand), on *umbelliferous plants*,

Puccinia apii (Celery Brand), on leaves of celery.

Puccinia angelicæ, on *angelica sylvestris*.

Puccinia bulbocastani, on *bunium bulbocastanum*.

Puccinia *Æthusæ*, on *Æthusæ cynapium*.

Puccinia *smyrnii* (Alexander's Brand), on *smyrnum olusatrum*.

Puccinia *adoxa* (Muschatel Brand), on *adoxa muschatellina*.

Puccinia *fabæ* (Bean Brand), on Beans.

Puccinia *circæ* (Night-shade Brand), on *circæ lutetiana*.

Puccinia *epilobii* (Willow-herb Brand), on *epilobium*.

Puccinia *umbilici* (Pennywort Brand), on *cotyledon umbilicus*.

Puccinia *spergulæ*, on *spergula arvensis*.

Puccinia *lychnidearum* (Lychnis Brand), on *lychnidæ*.

Puccinia *violarum* (Violet Brand), on wild violets.

Puccinia *calthæ* (Marsh Marigold Brand), on leaves of *calthæ palustris*.

Puccinia *chrysosplenii* (Golden Saxifrage Brand), on *chrysosplenium oppositifolium*.

Puccinia *noli-tangeris* (Balsam Brand), on *impatiens noli-tangere*.

Puccinia *Fergussoni*, on leaves of *viola palustris*.

Puccinia *mœhringiæ*, on *mœhringia trinervis*.

Puccinia *silenes*, on *silena inflata*.

Puccinia *rhodiolæ* (stonecrop Brand), on *sedum rhodiola*.

Puccinia pulverulenta (Great Willowherb Brand), on
epilobium montanum and E. hirsutum.

Puccinia prunorum (Plum tree Brand), on leaves of
plum trees.

Puccinia buxi (Box Brand), on leaves and stalks of box.

Puccinia fallens (Vetch Brand), on leaves of vicia
sepium.

Uromyces sparsa (Sandwort Rust) on spergularia rubra.

Uromyces graminum (Coltsfoot Rust), on dactylis
glomerata.

Uromyces polygoni (Knotgrass Rust), on polygonum
aviculare.

Uromyces intrusa (Ladies' Mantle Rust), on alchimilla
vulgaris.

Uromyces behenis, on bladder champion.

Uromyces betœ, on betœ vulgaris.

Uromyces geranii (Geranium Rust), on leaves of
geranium.

Uromyces ficariæ (Pileworth Rust), on ranunculus
ficaria.

Uromyces apiculosa (Short-stem'd Rust), on dock, &c.

Uromyces ulmariæ (Golden Rust), on spirea ulmariæ.

Uromyces alliorum (Garlic Rust), on allium.

Uromyces appendiculata (Long-stem'd Rust), on leguminosæ, &c.

Uromyces limonii (Sea Lavender Rust,) on statice limonium.

Uromyces scrophulariæ (Figwort Rust), on scrophularia aquatica.

Uromyces concomitans, on scrophularia nodosa.

Uromyces excavata, on euphorbia exigua.

Uromyces junci, (Rush Rust), on rushes.

Uromyces concéntrica, (Hyacinth Rust), on wild hyacinth.

Uredo hypericum (St. Johns' Wort Uredo), on hyperica.

Uredo Filicum (Fern Uredo), on cystopteris fragilis and other ferns.

Uredo potentillarum (Potentilla Uredo), on rose leaves and stalks.

Uredo pustulata (Willow Herb Uredo), on epilobium palustre.

Uredo saxifragarum (Saxifrage Uredo), on saxifrages.

Uredo alliorum (Garlic Uredo), on allium.

Uredo caryophyllacearum (Stitchwort Uredo), on various caryophyllaceæ.

Uredo prophyroginata (Bird Cherry Uredo), on prudus padus.

Uredo quercus (Oak Uredo), on oak leaves.

Uredo vacciniorum (Bilberry Uredo), on bilberry leaves

Uredo orchidis (Orchis Uredo), on orchis, &c.

Uredo confluens (Mercury Uredo), on mercurialis perennis.

Uredo Euonymi (Spindle Uredo), on Euonymus Europaeus.

Uredo Tropæoli (Nasturtium Uredo), on Tropæolum aduncum.

Uredo empetri (Crowberry Uredo). on euonymus Europaeus.

Uredo bifrons (Twinfaced Uredo), on sorel.

Uredo circæa (Night Shade Uredo), on circæa lutetiana.

Uredo statices (Sea Lavender Uredo), on statice.

Coleosporium petasitis (Butterbur Rust), on tussilago Petasites.

Coleosporium pingue (Tawny Rose Rust), on roses.

Coleosporium tussilaginis (Coltsfoot Rust) on tussilago.

Coleosporium miniatum (Orange Rose Rust), on wild roses.

Coleosporium sonchi-arvensis (Sow Thistle Rust), on *sonchus*.

Coleosporium campanulæ (Campanula Rust), on various *campanula*.

Coleosporium Rhinanthalacearum (Cow-wheat Rust), on *euphrasia officinalis*, &c.

Coleosporium symphyti (Comfrey Rust), on comfrey.

Coleosporium cacaliæ, on leaves of *cacalia*.

Coleosporium ochraceum (Agrimony Rust), on *agrimonia eupatoria*.

Coleosporium senecionis (Groundsel Rust), on various groundsel.

Cystopus spinulosus (White Thistle Rust), on thistles.

Cystopus cubicus (Goatsbeard White Rust), on goatsbeard, &c.

Cystopus candidus (Crucifer White Rust), on cabbage, shepherd's purse, &c.

Cystopus lepigoni (Sandwort White Rust), on *spergularia*

Lecythea Rosæ (Rose Rust), on rose leaves.

Lecythea saliceti (Common Willow Rust), on willow leaves.

Lecythea ruborum (Bramble Rust), on bramble leaves.

Lecythea poterii (Burnet Rust), on *poteriam sanguisorba*

Lecythea populina (Poplar Rust), on birch and poplar.

Lecythea mixta (Orange Willow Rust), on leaves of willows.

Lecythea euphorbiæ (Spurge Rust), on euphorbia, &c.

Lecythea epitea (Tawney Willow Rust), on under surface of willow leaves.

Lecythea lini (Flax Rust), on linum catharticum.

Lecythea Baryi (De Barry's Rust), on brachypodium pennatum.

Lecythea capræarum (Sallow Rust), on leaves of sallows

Lecythea valerianæ (Valerian Rust), on valeriana officinalis.

Lecythea gyrosa (Ringed Rust), on raspberry and bramble leaves.

Trichobosis cichoracearum (Hawkweed Rust), on thistles, &c.

Trichobasis caricina (Sedge Rust), on carex, &c.

Trichobasis pyrolæ (Wintergreen Rust), on pyrola rotundifole.

Trichobasis rubigo-vera (Round Corn Rust), on grasses and corn.

Trichobases linearis (Long Corn Rust), on leaves of corn, &c.

Trichobasis glumarum (Glume Rust), on glumes of cereals.

Trichobasis petroselini (Parsley Rust), on umbellifera.

Trichobasis oblongata (Luzula Rust), on luzula.

Trichobasis artemisiæ (Mugwort Rust), on artimesia vulgaris.

Trichobasis lychnidearum (Chick-weed Rust), on chickweed.

Trichobasis cirsii, on thistles.

Trichobasis angelicæ, on angelica.

Trichobasis Labiatarum (Mint Rust), on labiatæ

Trichobasis clinopodii, on clinopodium.

Trichobasis lapsana, on lapsana communis.

Trichobasis apii, on celery.

Trichobasis pimpinellæ, on pimpinella leaves.

Trichobasis conii, on conium.

Trichobasis cynapii, on æthusa cynapium.

Trichobasis rumicum, on rumex.

Trichobasis heraclei (Hogweed Rust), on heracleum.

Trichobasis betæ (Beet-leaf Rust), on beet.

Trichobasis impatiens, on leaves of impatiens.

Trichobasis umbellatarum, (Hemlock Rust), on umbelliferæ.

Trichobasis hydrocotyles (Flukewort Rust), on hydrocotyle.

Trichobasis fabæ (Bean Rust), on bean leaves.

Trichobasis galii (Bedstraw Rust), on galium.

Trichobasis suaveolens (Thistle Rust), on thistle leaves.

Trichobasis vincæ (Perriwinkle Rust), on vinca major.

Trichobasis parnassiæ (Parnassus Rust), on *P. palustris*.

Trichobasis primulæ (Primrose Rust), on primrose leaves.

Trichobasis fallens (Clover Rust), on clover leaves.

Trichobasis polygonorum (Knotgrass Rust), on *aviculare*, &c.

Trichobasis violarum (Violet Rust), on wild violets.

Trichobasis epilobii (Willow-herb Rust), on *epilobium*, &c.

Trichobasis iridis (Iris Rust), on *iris fœtidissima*.

Peronospora interstitialis, on primrose leaves

Peronospora sparsa (Rose Mould), on rose leaves.

Peronospora sordida (Figwort Mould), on scrophularia.

Peronospora schleideniana, on allium.

Peronospora calotheca, on galium.

Peronospora trifoliorum (Clover Mould), on lucern.

Peronospora hyoscyama (Henbane Mould), on common henbane.

Peronospora ficariæ (Figwort Mould), on *ranunculus ficaria*.

Peronospora violæ (Violet Mould), on wild violets.

Peronospora arenariæ (Sandwort Mould), on various plants.

Peronospora parasitica (Cabbage Mould), on crucifers

Peronospora pygmæa (Anemone Mould), on wood anemone.

Peronospora infestans (Potato Blight), on leaves of potato.

Peronospora gangliformis (Lettuce Mould), on composite plants.

Pernospora nivea (Parsnip Mould), on umbelliferæ

Pernospora viciæ (Pea Mould), on peas, &c.

Pernospora effusa (Spinach Mould), on goosefoot, &c.

Pernospora urticæ (Nettle Mould), on leaves of nettles.

Pernospora Lamii (Dead Nettle Mould), on *lamium rubrum*.

Peronospora entospora (Flebane Mould), on *erigeron*.

Peronospora grisea (Veronica Mould), on *veronica*.

Peronospora arborescens (Poppy Mould), on corn poppy

Peronospora violacea (Scabious Mould), on violet.

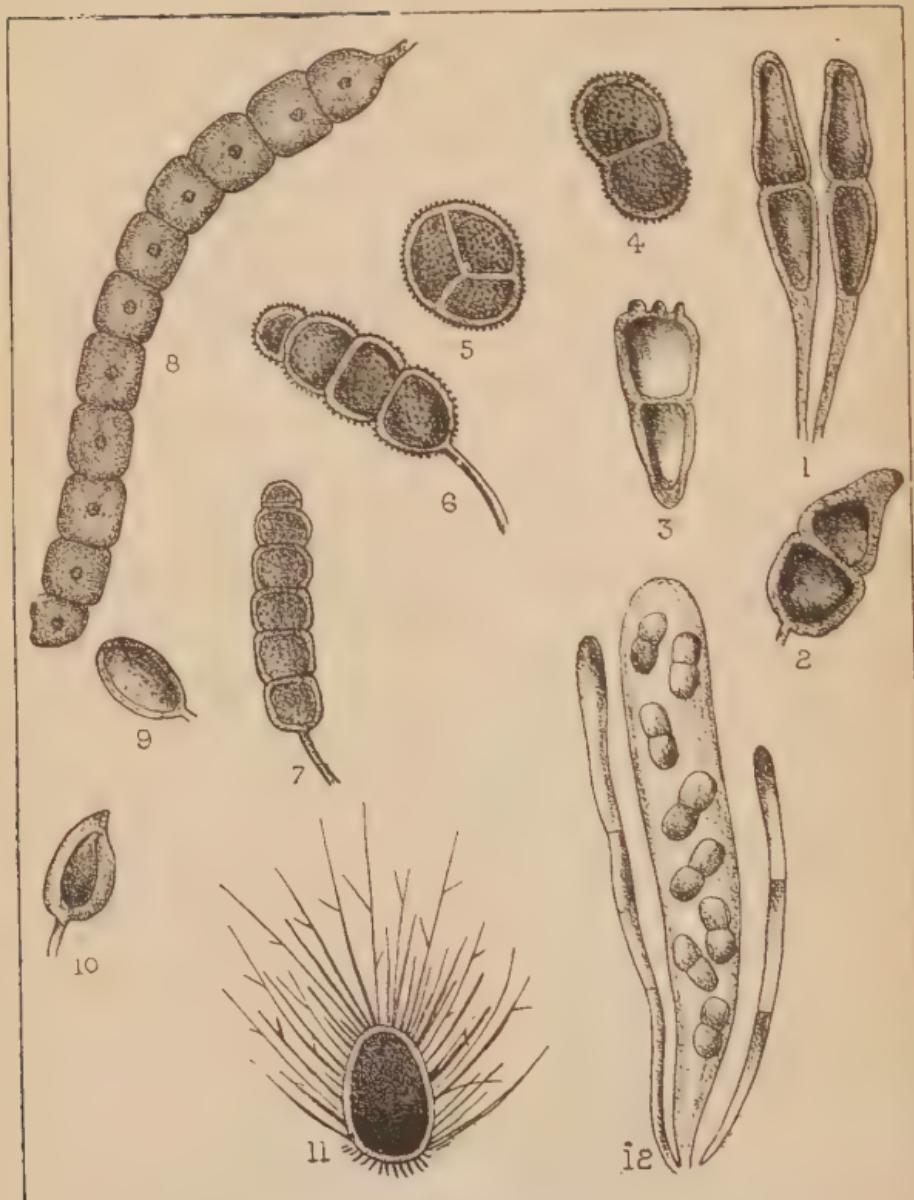
Peronospora candida (Primrose Mould), on leaves of primrose.

Pernospora obliqua (Dock Mould) on sorrel, &c.

Peronospora rufibasis, on leaves of myrica gale.



PLATE I.





EXPLANATION OF PLATES.

PLATE I.

Figure 1 is a representation of the usually scattered positions assumed by the Goatsbeard Clustercups (*Aecidium Tragopogonis*). When infested it is usually found that nearly every leaf of the plant is thus spotted over with the fungus. The Clustercups are bright orange in colour. The Anemone Clustercups (*Aecidium leucospermum*) possess a similar arrangement of the cups, but they are chiefly aggregated towards the edges of the leaves, and are, when growing on the leaf, a pure white. This scattered arrangement is found in *Aecidium Epilobii*, and numerous other clustercups. In *Ranunculus* Clustercups the cups are collected in more or less rounded patches, as is also

the case with the Berberry Clustercups. In nettles, and some other plants, the parasite attacks the stalks, and has an injurious effect upon the sap, when the stalks become swollen and distorted. Other and various arrangements of position of clustercups on plants will be met with by the student.

Figure 2 represents a side view of two clustercups of *Aecidium leucospermum*. This view can easily be obtained by cutting a section across the leaf. In the Berberry clustercup the fungus is much more elongated. The various species differ considerably as to what may be called the height to which they grow.

Figure 3 represents a section of *Aecidium Grossulariae* from my cabinet, an admirable preparation by John Barrow, Esq., of Manchester. The cup is partially open, and spores are rising to escape. We see but comparatively few spores, as doubtless a large quantity of them would escape during the preparation of the object.

Figure 4. This represents the position of *Ræstelia cornuta*, as seen upon the leaf of the mountain ash. Other species of *Ræstelia* vary as to the position they assume on the plant. The one on the hawthorn

(*Ræstelia lacerata*) generally distorts the smaller twigs.

Figure 5 represents a fragment of *Peronospora infestans*, copied from a slide in my cabinet. The spores of the different members of the genus differ somewhat as to the mode of their arrangement, as also in size and shape.

Figure 6 represents *Erysiphe lamprocarpa*, a fungus found upon various plants, amongst them *Salsify*, *Scorzonera* and Plantain. It belongs to a very interesting group of microscopic plants, with radiating appendages, all worthy of careful study, and some of singular beauty.

Figure 6x represents an ascus, or fruit-bearing vessel, of *Erysiphe lamprocarpa*, with its two sporidia as usually seen.



PLATE II.

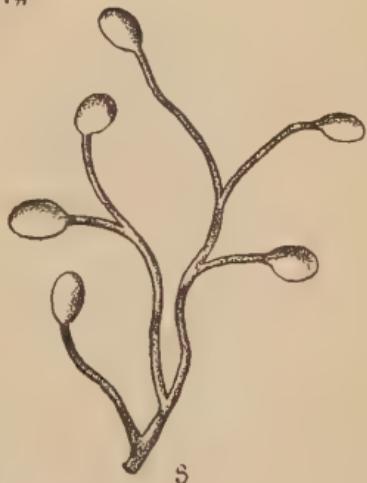
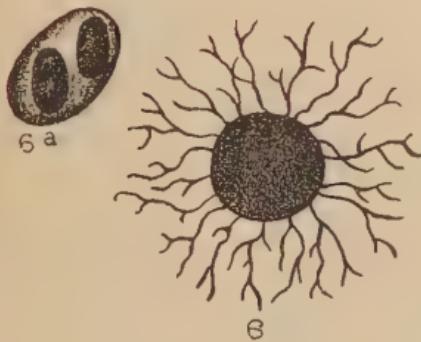
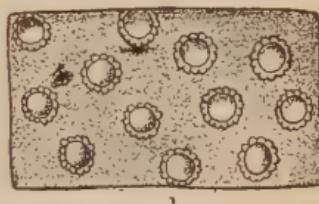
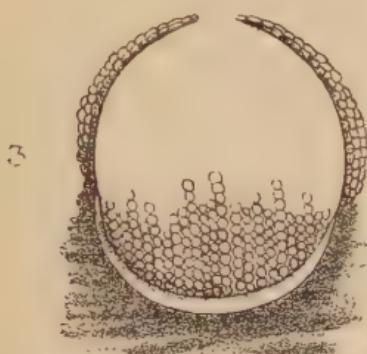
Figure 1 represents the general appearance of *Puccinia graminis* (Corn Mildew), and it is not difficult to meet with on the culms and leaves of corn or grass. Straw of the farmyard may frequently be found largely infested with it. The writer has obtained his best specimens from such straw.

Figure 2. *Puccinia Glechomatis* (Ground-Ivy Brand). It is to be found on various species of veronica.

Figure 3. *Puccinia coronata* (Coronated Mildew, or crowned puccinia.) It may be met with on various grasses. The student, in his examination of this fungus, must not expect all the spores to be crowned as represented in the engraving, for frequently, amongst a large mass of the spores, only a few will thus be decorated.

Figure 4. *Puccinia Anemones* (Anemone Brand). Plentiful in the season on the common wood anemone. It is remarkable for being dotted over with minute protuberances. The two cells are nearly round.

PLATE II.



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Figure 5. *Triphragmium ulmariae* (Meadow Sweet Brand). This interesting compound fungus is developed upon the well-known meadow sweet (*Spirea ulmaria*) in autumn.

Figure 6. *Phragmidium bulbosum* (Bramble Brand). The spores grow upon the leaves of the bramble in tufts, and are usually four-septate.

Figure 7. *Phragmidium gracile* (Raspberry Brand). Grows in small tufts chiefly upon the leaves of the wild raspberry, and occasionally on the cultivated plant.

Figure 8. *Zenodochus carbonarius* (Burnet Chain Brand). Composed of a string of articulations of about ten or twelve in number, occasionally several more. In certain districts it is annually met with in plenty on the larger Burnet *Sanqisorba officinalis*.

Figure 9. *Trichobasis rubigo-vera* (Corn Rust), in its young condition; afterward the small stalk or peduncle becomes detached.

Figure 10. *Uromyces alliorum* (Garlic Rust). The peduncle is of considerable length, and this is a general characteristic of the various species of the *Uromyces*.

Figure 11. *Chætomium elatum* (Straw Brittle Mould).

Very common on rotting straw.

Figure 12. Ascus of *Nectria pulicaris* (Blackish Nectria).

The central figure represents the organism in its perfect condition, with its eight spores fully developed.

I think it is desirable I should notice, for the information of the reader, that the representation of spores must be accepted as an approximation to their common appearance, for it will be found in numerous cases that they vary considerably in form and magnitude; also that with the spores for which he may be in search, as for example say *Puccinia Vincæ*, he will probably find numerous Ureda spores (*Trichobasis Vincæ*) mixed up with them on the same plant (*Vinca major*). This characteristic of the fruit of micro-fungi prevails extensively, and if borne in mind by the student in his microscopic investigations, will aid him in arriving at correct conclusions.



ERRATA.

Page 27, line 7, for *leucospirmum*, read *leucospermum*.

„ 33, „ 10, „ *epilebii* „ *epilobii*.
„ 33, „ 13, „ *hirsuta* „ *hirsutum*.
„ 35, „ 25, „ *Budumia* „ *Badhamia*.
„ 44, „ 8, „ *gramminis* „ *graminis*
„ 50, „ 2, „ *gramminis* „ *graminis*.
„ 55, „ 19, „ *Spherobolus* „ *Sphærobolus*.

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